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Tulsa Tornado Tribune

"Where People Who Know The Weather Get Their Weather"

National Weather Service Tulsa, Oklahoma

Summer, 2006

SEVERE WEATHER 2006

The severe weather season started with the outbreak of tornadoes on March 12 that affected Delaware and Benton Counties. Ultimately, this would prove to be the most significant tornado event of another relatively quiet season.

As March came to a close, severe storms battered portions of southeast Oklahoma and west central Arkansas on the evening of the 30th. Most of the severe weather was associated with a single long-track supercell , which produced a swath of nickel to quarter size hail through Pittsburg, Haskell, Sequoyah, and LeFlore counties in eastern Oklahoma. As the storm approached Fort Smith, it began to exhibit strong low-level rotation. A tornado warning was issued, but no tornadoes were sighted. The cell did produce quarter size hail in Fort Smith and Van Buren, then damaging winds near Altus.

April picked up where March left off, with severe weather affecting much of northeast Oklahoma and northwest Arkansas in the late evening hours of the 1st and early morning of the 2nd. Most significantly, a brief tornado touched down near Tulsa International Airport around 1115 pm. Although it lasted less than a minute, the tornado damaged the Radisson Hotel, where a portion of roof was lost over 3 rooms and numerous windows were blown out. Also, an SUV was flipped over in the parking lot. The tornado appeared to be spawned on the leading edge of the line of storms. The same line of storms produced winds of 60 to 70 mph, downing numerous trees and power lines in Foyil, OK, and later causing damage in Benton and Madison Counties in Arkansas.

The action continued a few days later as three tornadoes were sighted in eastern Oklahoma on the 6th, though none were significant. The only damage reported was 6 miles northeast of Hollow, where the roof was blown off a mobile home. Other tornadoes were sighted 12 miles west of Hominy and over Lake Eufaula, but were very brief

(Please see **Severe** *on page 3)*

Editor's Notes

The heat of summer appears to be in full swing. On page five, in the article entitled "Heat Stress", please note that the heat related products issued by NWS Tulsa have changed a little this year to include Excessive Heat Watches and Warnings in addition to Heat Advisories.

As always, special thanks are in order to those who helped us out during our severe weather season!

Craig A. Sullivan - Editor

MIDTOWN MICROBURST

Midtown Tulsa residents awoke to the destructive force of an early morning thunderstorm on June 6, just before 6 am. An extensive swath of straight-line wind damage was reported from areas just to the east of downtown Tulsa, eastward to near Broken Arrow.

The destructive winds were the result of a **microburst**, a localized rush of downdraft winds from a collapsing thunderstorm cell, which produced wind gusts estimated near 80 mph.

On page two, **Anatomy of a Microburst** illustrates the development of this storm as it appeared on radar.

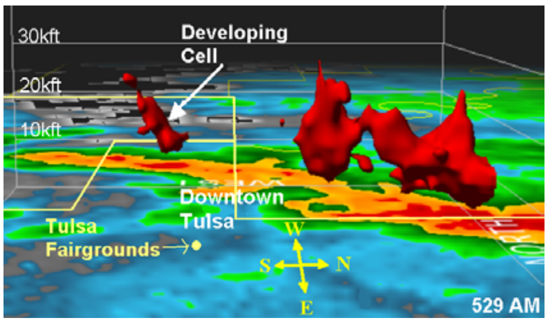
Inside this issue:

Anatomy of a Microburst

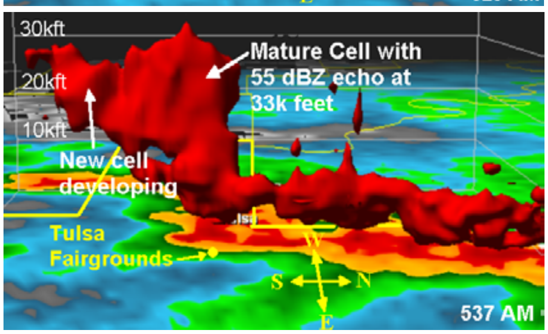
The microburst that struck midtown Tulsa early in the morning of June 6 was not all that unusual...this time it just happened to be in a densely populated area. This series of radar images taken from that morning illustrate the 3-D structure of the storm producing the microburst, using a new software program called GR2Analyst, which is used in researching storms after the fact.

The images also show just how quickly this particular storm went through its life-cycle. The sequence from initial cell development through the mature and dissipating stages took place in a little over 15 minutes! This, too, is not an unusual feature of microburst-producing storms and makes them very difficult to detect and issue warnings with significant lead time.

Development

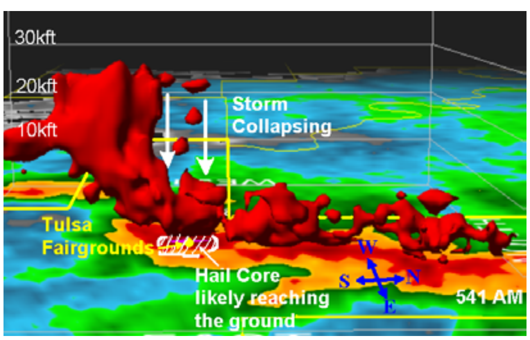


These 3-D reflectivity images show the rapid development of an intense cell west of downtown Tulsa. The red indicates reflectivity values greater than 55 dBZ. The cell developed on the south end of a line of storms, which had not produced severe weather.

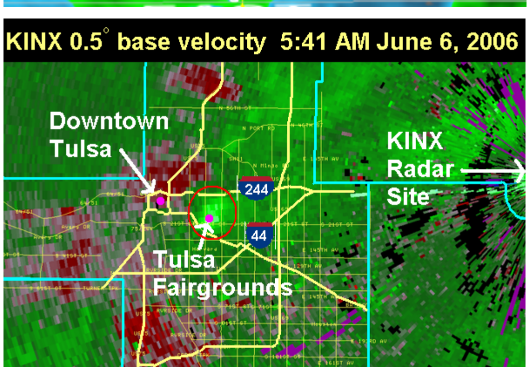


Eight minutes (two radar volume scans) later, an intense core aloft developed, prompting a Severe Thunderstorm Warning to be issued. No velocity signature was noted near the ground, but a hint of stronger winds could be seen near 7,000 feet AGL.

Initial Severe Weather

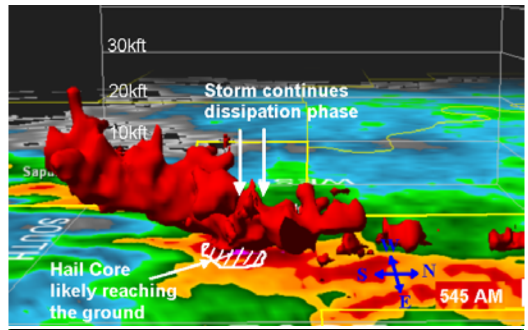


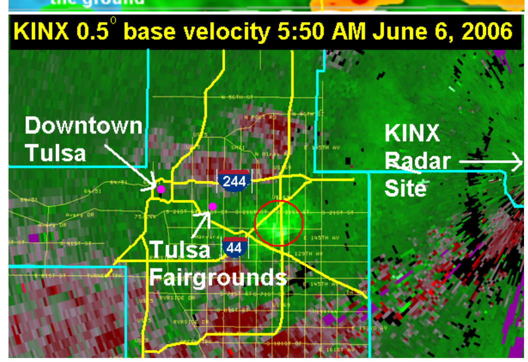
The next scan, taken just four minutes later, shows the intense core that developed west of downtown Tulsa had significantly weakened in the upper levels, but a high reflectivity core (>65 dBZ) had reached the ground, indicating large hail at the surface. A new mature cell is seen to the south.



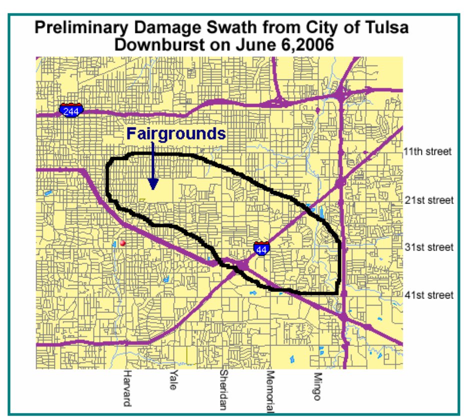
At the same time, a small area of 50 knot inbound velocities (circled in red), centered over the Fairgrounds, appeared at about 1000 feet AGL. About this time, the first report of wind damage came from just west of the Fairgrounds. Interestingly, large hail fell downtown, but no wind damage was reported.

Wind Damage Continues





By the next scan (top), the southern cell had begun to collapse, which probably contributed further to the damaging winds at the surface. The velocity image taken five minutes later (middle) shows the high inbound velocities (circled) spreading out to the east. The track of the velocity signature corresponds well to the swath of wind damage (below).



Severe

(Continued from page 1)

and did not cause any known damage. Significant straight line wind damage did occur 7 miles north of Welch and 2 miles east of Warner, where 2 outbuildings were destroyed and a mobile home damaged.

By now, 12 tornadoes had already occurred in Tulsa's County Warning Area (CWA). With the climatological peak of severe weather yet to come, it appeared we might be on our way to an active season. But the atmosphere played a dirty trick and brought summer a little early…a bad thing for storm chasers and gardeners alike!

Not to say that this was the end of severe weather for the season, however. Typically, the last week of April brings severe weather, and this year was no exception. April 24 saw three rounds of severe thunderstorms, making it the busiest day of the season in terms of warnings issued. A slow-moving round of storms affected areas mainly from Tulsa northward during the morning and early afternoon. Wind damage was reported in Hulah, Pawnee, and White Oak. As the storms passed through the Tulsa area, golf ball hail was reported in downtown Tulsa, Owasso, and Collinsville. Gusty winds damaged the roof and broke car windows in the parking lot at the building housing the NWS around 2 pm. The most significant damage from the first round occurred in Bixby just after 2 pm, as significant damage from a "gustnado" (see **ASIDE**) occurred along a path 1/2 mile long and 40 yards wide, including a car dealership downtown. A NWS survey found damage to trees and other structures consistent with wind speeds to about 70 mph.

A second line of storms developed early in the evening over central Oklahoma. One rotating supercell passed through Creek, Tulsa, and extreme southern Osage county, producing golf ball to baseball size hail. This storm showed strong rotation, and a wall cloud was sited near Sand Springs. Sirens sounded in the Tulsa area, but no tornadoes touched down. Another line of storms moved through northeast Oklahoma a couple of hours later, with 60 to 65 mph winds reported from Wynona to Owasso to Choteau.

Heavy rains were the story on the morning of May 4, as up to 5 inches of rain fell in a little over an hour in the Tulsa suburb of Broken Arrow and caused considerable urban flooding. Water rescues were conducted from at least two stranded vehicles and one home. Additional flooding occurred later that morning in Tahlequah and Stilwell where several roads were closed. Flooding caused Arkansas Highway 215 to be closed for a time near Shores Lake in Franklin County.

Early morning storms on May 9 produced considerable wind damage from northeast Oklahoma through northwest Arkansas, along with a brief tornado between Miami and Commerce around 5 am. The main show occurred later, as severe storms affected mainly southeast Oklahoma and west central Arkansas during the evening. Several trees were uprooted and outbuildings were damaged in Latimer County south of Gowen. Later, heavy rains became the concern with flash flooding near Antlers, OK, Charleston, AR, and Roland, OK. Torrential rains caused flooding of several homes in Fort Smith, with cars reported under water near 28th street.

Storms continued after midnight, with (in all likelihood) the spring's final tornado occurring 7 miles west-southwest of Hectorville in Okmulgee County around 1:40 a.m. The tornado destroyed 2 outbuildings, uprooted or snapped numerous trees, damaged a camper trailer, and produced damage to one house along a 1/2 mile long and 75 yard wide path. In addition, a swath of straight line wind damage 2 to 3 miles wide and 10 miles long was noted through Okmulgee County.

Much like April, May started active, but quickly turned to summer. Only four tornadoes were reported in Oklahoma during May, well below the average of 20, and not much better than last year's total of zero. The combined total of May tornadoes in 2005 and 2006 ranks as the lowest ever.

ASIDE: The damage pattern that was found during the survey of damage in Bixby, combined with radar data, strongly suggest that a shallow vortex (**red X**) along the thunderstorm gust front (**dashed white line**) produced this damage. This type of vortex is sometimes referred to as a "gustnado". It forms as a result of strongly changing winds (wind shear) along the leading edge of cool **downdraft** region. This type of vortex differs from a tornado in that a tornado is the result of air underneath a thunderstorm being stretched vertically by the thunderstorm updraft. The thunderstorm updraft area was at least 5 miles north of the gust front at the time the damage occurred in Bixby.

Current Drought: Unusual or Not?

Much has been made of the recent drought across the region, as most of Oklahoma and Arkansas have received much below normal precipitation since the beginning of 2005. The southeast Oklahoma climate division still remains mired in its driest 365 day period on record (as of early July), and most of the surrounding divisions rank in the top 10 driest. Looking at more long-term rainfall data, a precipitation deficit has been accumulating for some time now, all the way back to 2001 in northeast Oklahoma, in fact. Sound serious? You bet! Sound unprecedented? Not at all!

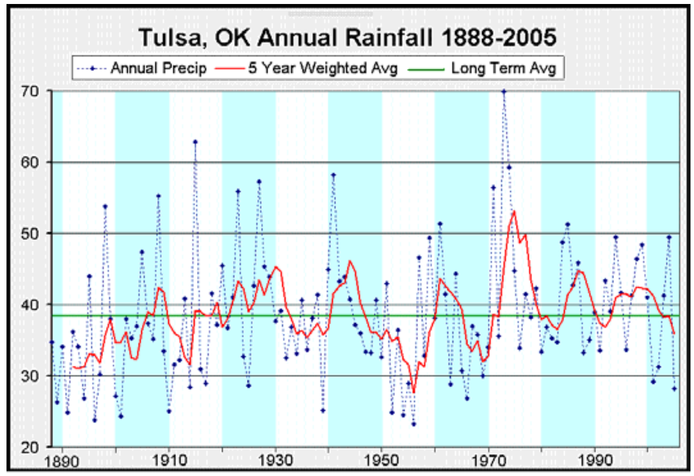
In reality, droughts occur throughout the world, and in any given year, at least one region is experiencing drought conditions. They also occur on varying time and spatial scales; some last only a few months or affect a localized region, but are no less devastating. Instrumental data shows that they are part of the natural cycle of weather, and thus, can be expected to recur from time to time.

For the latest updates on the current drought, visit the NWS Tulsa website www.srh.noaa.gov/tsa and click on "Drought Information"

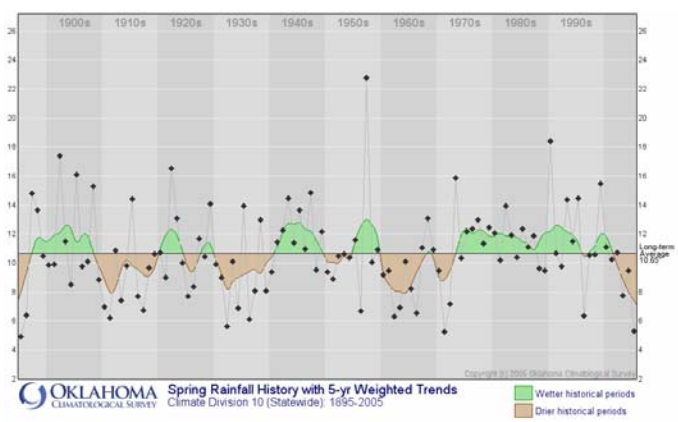
Where the current drought is headed is hard to say, but we can see how it stacks up (so far) to other droughts of the past century. The two major droughts of the 20th century, the 1930s Dust Bowl drought and the 1950s drought, lasted five to seven years and covered large areas of the continental U.S., including Oklahoma and Arkansas. The Dust Bowl drought remains more widely talked about, mostly due to a series of spectacular dust storms owed as much to naïve agricultural practices as the severity of the weather. However, in terms of rainfall deficit, the 1950s drought was more severe across the south central U.S.

The accompanying graphs show that the current drought is cause for alarm, but is it truly unprecedented? While instrumental records only date back a little over 100 years, the science of ***Paleoclimatology*** does tell more of the story. Records of rainfall are preserved in tree-rings, buried in the sediments of sand dunes and lakes, contained within historical documents, and preserved in archaeological remains. These records demonstrate patterns of natural drought variability and allow us to compare 20th century droughts with those of the past. Paleoclimatic data suggest that droughts as severe at the 1950s drought have occurred in central North America several times a century over the past 300-400 years, and thus we should expect (and plan for) similar droughts in the future.

(Please see **Drought** *on page 5)*



Above is a plot of annual precipitation (in inches) in Tulsa since 1888 (blue), with a 5 year weighted average of the data to indicate longer term periods of dry or wet weather (red), both compared to the long term average (green). There appears to be about a five to seven year cycle of wet and dry periods. Since much of the 1990s were a relatively wet period, perhaps we were due for a drought. Notice the current cycle has not yet reached the severity of the 1950s drought, but is comparable to the "Dust Bowl" years.



Graph generated by the Oklahoma Climatological Survey

A more disturbing trend shows up by examining spring (March-May) rainfall for all of Oklahoma. The five year weighted average rainfall has trended to levels lower than any time since 1900. This does not include the 2006 rainfall, which was also below normal. Because spring is the main growing season when the wheat crop matures and young calves are fattening up on grasses, the agricultural impacts are not hard to imagine. Interestingly, the 1930s "Dust Bowl" drought had much drier springs than those in the 1950s.

Heat Stress

Increased Risk Factors

Anyone who spends time outdoors in hot weather runs a risk of developing heat stress, but the conditions listed at right may increase a person's risk significantly. In addition, many medications can make you more vulnerable to the heat. If you take medicine for high blood pressure, nervousness, depression, poor circulation or sleeplessness, you should check with your doctor or pharmacist for advice.

- Weak or damaged heart
- Hypertension
- Poor circulation
- Diabetes
- A previous stroke
- Being overweight
- Infection or fever
- Diarrhea
- Skin diseases or existing sunburn

Serious Symptoms

Hot weather makes most people feel uncomfortable and may cause a lack of energy or slight loss of appetite. The symptoms listed below indicate more advanced stages of heat stress and demand immediate medical attention:

- Dizziness
- Rapid heartbeat
- Diarrhea
- Nausea
- Throbbing headache
- Dry skin
- Chest pain
- Significant weakness
- Mental changes
- Breathing problems
- Vomiting
- Cramps

What You Can Do

- **Keep Cool** by spending time in cooler surroundings; e.g. an air-conditioned mall, library, or movie theatre.
- **Use a Fan** to draw cool air into your home at night or help provide good indoor air-circulation during the day.
- **A Cool Bath** provides relief from heat. Cool water removes extra body heat 25 times faster than cool air.
- **Wear Lightweight, Loose Fitting Clothing.**
- **Drink Plenty Of Fluids**, but don't wait until you are thirsty.
- **Slow Down**, especially at the start of hot weather when your body is less prepared for the heat
- **Watch What You Eat**, avoiding hot foods and heavy meals which add heat to your body
- **Avoid Alcohol**

NWS Products

Some changes have been made to the suite of heat-related products issued by the National Weather Service.

New! **Excessive Heat Watch**: Two or more days of maximum heat indices of 105 or more and low temperatures of 80 or more are **possible**.

New! **Excessive Heat Warning**: Two or more days of maximum heat indices of 105 or more and low temperatures of 80 or more are **expected** or **occurring**.

Heat Advisory: Same criteria as Excessive Heat Warning, but for less than two days.

Record Warm Spring

Spring 2006 will go down in the books as the warmest meteorological spring (March-May) on record for both Oklahoma and Arkansas. All three months saw above average temperatures, but April took home the prize for all-time warmest in Oklahoma, and second warmest for Arkansas. Nationwide, spring 2006 was the fourth warmest on record, with April ranking as the warmest ever.

When combined with the mild winter temperatures experienced, including the warmest January ever recorded, the January through May temperatures were also the warmest on record for Oklahoma, and the 5th warmest for Arkansas. The mean statewide temperature in Oklahoma was 1.5 degrees warmer than January through May of 1986, which held the previous record. While Arkansas was not quite as warm during the period, it still saw its warmest January through May since 1938.

Top 5 Warmest Springs (monthly avg. temp.)

Fort Smith	
2006	64.7
1938	64.4
1921	64.2
1925	64.1
1936	63.9
Tulsa	
1936	64.9
1925	64.6
2006	64.2
1991	64.2
1977	64.0

Drought

(Continued from page 4)

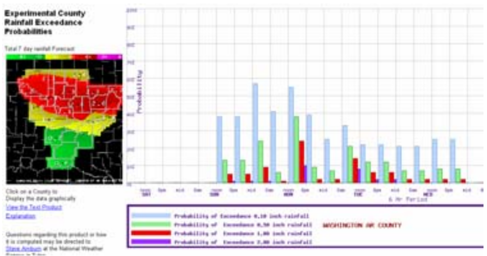
The paleoclimatic record also indicates that droughts of a much greater duration than any in the 20th century have occurred in parts of North American as recently as 500 years ago. These data indicate that we should be aware of the *possibility* of such droughts occurring in the future as well. The occurrence of such sustained drought conditions today would be a natural disaster of a magnitude unprecedented in the 20th century.

Of course, none of this is to suggest that the current drought is a calamity in the making, but it is part of the natural cycle of things. More importantly, it tells us that this too shall pass…eventually.

Local News

Experimental Precipitation Forecasts

NWS Tulsa has a new experimental product, which gives our best estimate of the probability to exceed certain rainfall amounts. (e.g. a 30 percent chance of receiving at least one inch).



On the left side is the estimated 7 day average precipitation expected for our area. Click on any county in the map and it will display a bar chart for that county. The bars represent the probability to exceed the specified rainfall amounts for 6-hour periods, e.g. noon to 6 pm, or 6pm to midnight.

The probabilities are unconditional; that is, they represent the chance that any given location will exceed the specified rainfall amounts, whether or not it rains. So, these probabilities can be used much like our standard rainfall probability forecast, which is the probability to exceed 0.01 inches of rain.

These probabilities are on our web page and can be seen by clicking on the "New Experimental Probabilistic Precipitation Forecasts" bullet to the left of the Decision Support Page window.

If you have any questions about this product, please contact Steve Amburn, Science and Operations Officer at NWS Tulsa.

Employee Milestones

Two WFO Tulsa Senior Forecasters recently reached significant career milestones. Richard Uber was recognized for 35 years of federal service, including four years in the United States Air Force. Richard was one of the original group of forecasters who arrived at WFO Tulsa in 1990.

Max Blood was recognized for his 30 years of federal service, all with the NWS. Max has been with the Tulsa office since 2003. Congratulations Rich and Max!

The Graduate

Congratulations are also in order for Electronics Systems Analyst Isaiah Daniels, who recently completed the requirements for a Bachelor of Science degree in Information Technology. What's more, Isaiah completed his coursework while working full time at NWS Tulsa!

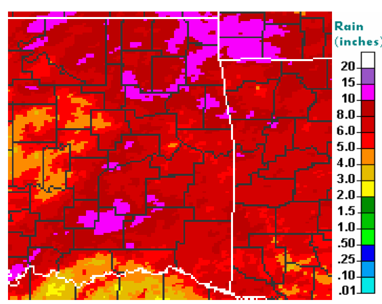
Spring Rains

Drought conditions were finally eased some during the spring, as several rounds of widespread rainfall drenched eastern Oklahoma and northwest Arkansas in April through the first week of May.

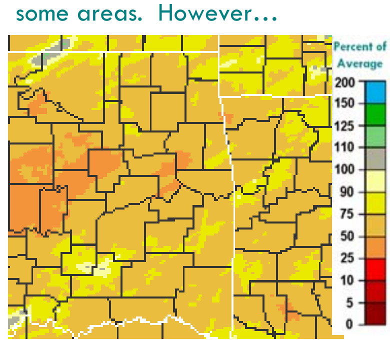
The NWS experimental 30 day precipitation graphics ending May 10 showed most of eastern Oklahoma and western Arkansas receiving at least 6 inches of rain during that time frame. In addition, far northeast Oklahoma and far northwest Arkansas received over 10 inches of rain during the two week period.

However, precipitation for the spring season still finished below normal in most of the region, and water year (since October 1) totals remained much below normal.

The rain was by no means enough to end the drought, but did take the area out of the extreme and exceptional drought categories. Currently, most locations north of the Arkansas River remain in the abnormally dry category, which is not part of the drought scale. Only a small portion of southeast Oklahoma remains in the severe drought category.



NWS aerial rainfall graphic for the period April 10 to May 10, 2006 shows over 10 inches fell in some areas. However…



The percent of average rainfall for the water year to date (October 1 - May 10) paints a different picture; still abnormally dry.

By the Numbers…

Statistical rainfall comparisons for three Oklahoma climate districts for four different periods ending May 10, 2006.

NE Okla.	% Avg.	Rank *
30 day	184	79
90 day	107	63
180 day	75	27
365 day	77	14

EC Okla.	% Avg.	Rank*
30 day	152	72
90 day	102	59
180 day	69	12
365 day	68	4

SE Okla.	% Avg.	Rank*
30 day	142	68
90 day	115	62
180 day	81	22
365 day	64	1

* 1=driest on record (1921-2006)